
Two New Edaphic Endemic Species and Taxonomic Changes in *Gladiolus* (Iridaceae) of Southern Africa, and Notes on Iridaceae Restricted to Unusual Substrates

Peter Goldblatt

B. A. Krukoff Curator of African Botany, Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.

John C. Manning

National Botanical Institute, P. Bag X7, Claremont 7735, South Africa

ABSTRACT. Two new species of the African and Eurasian genus *Gladiolus* occurring on unusual substrates are described from southern Africa. *Gladiolus serpenticola* is restricted to serpentine soils in the Barberton District, Mpumalanga Province, South Africa, and adjacent Swaziland and *G. pavonia* occurs on dolomite in Mpumalanga. *Gladiolus serpenticola*, unusually tall for the genus, stands 75–150 cm high, has small, dry floral bracts, and short-tubed, pale pink flowers. It appears to be most closely related to another Mpumalanga endemic, *G. hollandii*, and both belong to an alliance of eastern southern African species centered around the widespread *G. crassifolius*. *Gladiolus pavonia* has pale pink flowers and is most likely related to a complex of eastern southern African species, mostly of rocky habitats in montane grasslands. Three additional species of *Gladiolus* from Western Cape Province, South Africa, are recognized here: *G. miniatus*, *G. caeruleus*, and *G. variegatus*. The first is reinstated at species rank after having been reduced to a subspecies of *G. floribundus*. *Gladiolus caeruleus* and *G. variegatus* are raised from infraspecific rank in which they were treated as *G. gracilis* var. *latifolius* and *G. debilis* var. *variegatus*, respectively. All three of these species are restricted to limestone outcrops. *Gladiolus miniatus* and *G. variegatus* occur in the southern part of Western Cape Province, and *G. caeruleus* is restricted to a small area of the west coast of the Province. These five species join the small number of taxa of African Iridaceae listed here, now totaling 15, known to be endemic or largely restricted to unusual soil types.

Botanists have long recognized the striking effects of such azonal substrates as limestone, dolomite, gypsum, serpentine, and heavy metal soils (Kruckeberg & Rabinowitz, 1985; Kruckeberg,

1986). These substrates often harbor unusual plant associations and endemic species, and the new species recognized here fall into this category. As far as is known, relatively few of the estimated 1750 species of the family Iridaceae are narrow edaphic endemics of these unusual substrates, and none were mentioned by Wild (1978) in his survey of edaphic endemism in southern Africa. Just a handful of African Iridaceae fall into this category (Table 1), most of which belong in the genus *Gladiolus* L. To this short list we add five more species, two new to science and three raised from infraspecific rank. The new species are *G. serpenticola*, restricted to serpentine outcrops in the Barberton District, Mpumalanga Province, South Africa, and adjacent Swaziland, and *G. pavonia*, an apparently narrow endemic of dry dolomite slopes near Abel Erasmus Pass in the Drakensberg Mountains of Mpumalanga.

Three more species, *Gladiolus caeruleus*, *G. miniatus*, and *G. variegatus*, are recognized here, each currently regarded as local subspecies or varieties of more widespread taxa (Lewis et al., 1972). All are restricted to Tertiary limestone outcrops and calcium-enriched coastal sands of Western Cape Province. *Gladiolus miniatus* Ecklon is reinstated as a species, having been treated by Obermeyer in Lewis et al. (1972) as a subspecies of the widespread *G. floribundus*. It is unusual in being the only species of the *G. carneus*–*G. floribundus* alliance that is adapted for pollination by sunbirds. *Gladiolus caeruleus* is a new name at species level for *G. gracilis* var. *latifolius*, and *G. variegatus* is a new combination and rank for *G. debilis* var. *variegatus*. The nomenclatural changes and a discussion of their relationships are provided for each of the species raised from infraspecific rank, but full descriptions are not included here. Descriptions will be published in a systematic revision of *Gladiolus* in southern Africa, currently in preparation.

From the data available on substrate preferences in Iridaceae (Table 1), we conclude that the occurrence of endemic species on such soils is unusual and is restricted mainly to larger genera with 25 or more species, the exception being *Freesia* with just 15 species. The edaphic endemics appear in all cases to be neoendemics fairly closely related to extant species that occur on more normal soil types in the immediate vicinity. *Gladiolus*, with approximately 250 species, is possibly the most speciose genus of Iridaceae and the largest genus in subfamily Ixioidae; it also harbors the largest number of edaphic endemics.

SYSTEMATICS

1. *Gladiolus serpenticola* Goldblatt & Manning, sp. nov. TYPE: South Africa. Mpumalanga: Kaap Valley on Nelspruit-Barberton road near Noordkaap River bridge, serpentine outcrops, 9 Feb. 1994, Goldblatt & Manning 9844 (holotype, NBG; isotypes, E, K, MO, PRE, WAG). Figure 1.

Plantae 75–150 cm altae, cormo 3–5 cm in diametro, foliis 8–10 inferioribus 4–5 basalibus longioribusque anguste lanceolatis vel sublinearibus laminibus 7–10 mm latis, caule usitate ramoso, spica 18–30 florum, bracteis siccis brunneis attenuatis exteriore 12–16 mm longis, floribus pallide roseis vel subalbis tepalis lateralibus inferioribus flavis purpureisque notatis, tubo perianthii infundibuliforme 10–12 mm longo, tepalis inaequalibus dorsale 23 × 14 mm superioribus lateralibus 23 × 12 mm inferioribus 13–18 × 5.5–8 mm, filamentis 14 mm longis, antheris ca. 6 mm longis, capsulis globoso-ovatis apicibus trilobatis 5–8 mm longis, seminibus alis ca. 1.5 mm longis.

Plants 75–150 cm high. Corms depressed-globose, 3–5 cm diam., the tunics initially coriaceous and unbroken, fragmenting irregularly, becoming coarsely fibrous. Cataphylls coriaceous and pale, the uppermost reaching 8–12 cm above the ground and then green or flushed with purple. Leaves 8–10, the lower 4–5 ± basal and longest, reaching to about the base of the spike, gray-green, the blades narrowly lanceolate to linear, 7–10 mm wide, the remaining leaves caudine, progressively smaller above, imbricate and sheathing the stem to about the base of the spike. Stem erect, usually with 1–2 branches, occasionally more, 2–2.5 mm diam. below the base of the spike. Spike slightly inclined, ± straight, 18- to 30-flowered, the secondary axes with fewer flowers; bracts pale green in bud, dry and light brown above by anthesis, narrowly lanceolate, the apices attenuate, dry and twisted, 12–16 mm long, the inner bracts similar, ca. two-thirds as long as the outer. Flowers pale pink to nearly

white, the lower lateral tepals each with a central yellow streak surrounded by a light purple blotch, the yellow fading to purple with age, unscented; perianth tube obliquely funnel-shaped, 10–12 mm long; tepals broadly ovate, the dorsal inclined to hooded over the stamens, 23 × 14 mm, upper laterals directed forward, weakly curving upward in the distal third, 23 × 12 mm, lower 3 tepals united for ca. 2 mm, the lower laterals shortly clawed gradually expanded into the limbs, 13–14 × 5.5–6 mm, the lower median 16–18 × ca. 8 mm, arching downward, much exceeding the lower laterals. Filaments 14 mm long, exserted ca. 8 mm from the upper part of the tube; anthers ca. 6 mm long, purple, the pollen cream. Ovary ovoid, ca. 2.5 mm long; style arching over the stamens, dividing opposite the lower to upper third of the anthers, the branches ca. 2 mm long, not reaching the anther apices. Capsules ovoid, three-lobed apically, 5–8 mm long; seeds ovate, ca. 5–6 × 2.5–3 mm, the wing ca. 1.5 mm long, unevenly developed, sometimes lacking on one side or across the middle.

Flowering early February to late March, rarely in late January.

Etymology. A combination of serpentine, the substrate on which the species grows, and the Latin, “icola,” living on, thus *serpenticola*.

Distribution and habitat. *Gladiolus serpenticola* is endemic to the Barberton District of Mpumalanga Province, South Africa. Plants occur widely across the low-lying Kaap Valley, the floor and lower edges of which have extensive outcrops of verdite, a dark green form of serpentine. Soils derived from this substrate are relatively inhospitable to plants (Morrison et al., 1989) because they have high concentrations of toxic minerals, including unusually high magnesium/calcium ratios and potentially toxic concentrations of chromium and nickel, and because they are often associated with high levels of iron and cobalt.

Diagnosis and relationships. The distinguishing features of *Gladiolus serpenticola* are the tall stature, 75–150 cm high, narrow glaucous leaves, 7–10 mm wide, and small dry brittle floral bracts only 12–16 mm long. The relatively small, pale pink flowers with pale mauve markings on the lower lateral tepals and the short perianth tubes, 10–12 mm long, are unremarkable in the genus and closely resemble those of related species such as *G. densiflorus* and *G. crassifolius*. Like the majority of eastern southern African species of *Gladiolus* with small flowers, *G. serpenticola* has short, ovoid to oblong capsules with broadly trilobed apices and small seeds with narrow, poorly developed wings.

Table 1. Edaphic endemic species of African Iridaceae. Total number of species per genus is indicated in parentheses after the genus name. D = dolomite, L = limestone, S = serpentine, H = heavy metal enriched.

Species	Substrate	Distribution range
<i>Gladiolus</i> (ca. 250 spp.)		
<i>G. actinomorphanthus</i> Duvigneaud & van Bokstal	H	Shaba Province, Zaire
<i>G. calcicola</i> Goldblatt	L	southern Ethiopia
<i>G. caeruleus</i> Goldblatt & J. Manning	L	W. Cape coast, South Africa
<i>G. dolomiticus</i> Obermeyer	D	Northern Province, South Africa
<i>G. ledoctei</i> Duvigneaud & van Bokstal	H	Shaba Province, Zaire
<i>G. miniatus</i> Ecklon	L	S. Cape coast, South Africa
<i>G. pavonia</i> Goldblatt & J. Manning	D	Mpumalanga Province, South Africa
<i>G. robiliartianus</i> Duvigneaud & van Bokstal	H	Shaba Province, Zaire
<i>G. tshombeanus</i> Duvigneaud & van Bokstal	H	Shaba Province, Zaire
<i>G. vaginatus</i> G. Lewis	L	S. Cape coast, South Africa
<i>G. variegatus</i> (G. Lewis) Goldblatt & Manning	L	W. Cape coast, South Africa
<i>Freesia</i> (15 spp.)		
<i>F. elimensis</i> L. Bolus	L	S. Cape, South Africa
<i>Hesperantha</i> (ca. 60 spp.)		
<i>H. juncifolia</i> Goldblatt	L	S. Cape coast, South Africa
<i>Ixia</i> (45 spp.)		
<i>I. acaulis</i> Goldblatt & Manning	L	Namaqualand, South Africa
<i>Moraea</i> (125 spp.)		
<i>M. calcicola</i> Goldblatt	L	W. Cape coast, South Africa
<i>M. loubseri</i> Goldblatt ¹	L	W. Cape coast, South Africa
<i>Tritonia</i> (ca. 30 spp.)		
<i>T. squalida</i> Aiton	L	S. Cape coast, South Africa
<i>Watsonia</i> (52 spp.)		
<i>W. fergusoniae</i> L. Bolus	L	S. Cape, South Africa

¹ Although thought to be restricted to soils derived from granite, the habitat of *Moraea loubseri* has been found to have a limestone deposit overlaying the granite basement, and it seems likely that the species is restricted to a limestone substrate (unpublished obs.).

The capsules of *G. serpenticola* are particularly small, only 5–8 mm long. Its relationships appear to lie most closely with a second eastern southern African species, *G. hollandii*. Also unusually tall and with relatively soft-textured leaves, *G. hollandii* has flowers with a perianth tube ca. 25 mm long, longer floral bracts 20–30 mm long, and larger capsules 10–20 mm long. It occurs on quartzitic and granitic soils from Pilgrim's Rest to Barberton in Mpumalanga southward to Goba in Mozambique and Hlatikulu in Swaziland.

Until now the few available collections of *Gladiolus serpenticola* have been confused with either *G. crassifolius* or *G. densiflorus*, both short-tubed species with similarly proportioned flowers that broadly resemble those of *G. serpenticola*. *Gladiolus crassifolius* can immediately be distinguished by its coarsely ribbed leaves with thickened and hyaline midribs, secondary veins, and margins, a sturdy stem, sharply inclined spike, and broader floral

bracts. *Gladiolus densiflorus* also has distinctive leaves with the midrib and margins slightly thickened and the remaining veins fine and closely set.

Paratypes. SOUTH AFRICA. Mpumalanga: 2530 (Lydenburg) 1 km from the Noordkaap River bridge on the road to Barberton (DB), 14 Apr. 1994 (fruit), Manning 2108 (NBG); 2531 (Barberton) 14 km to Noordkaap from Nelspruit-Barberton road (CA), 10 Mar. 1983, Reid 721 (PRE). SWAZILAND. 2631 (Mbabane) Hlatikulu [?District], Mar. 1911, Stewart s.n. (K, PRE).

2. *Gladiolus pavonia* Goldblatt & Manning, sp. nov. TYPE: South Africa. Mpumalanga: dolomite hill slopes between the top of Abel Erasmus Pass and Strydom Tunnel, 6 Dec. 1994, Goldblatt & Manning 10131 (holotype, NBG; isotypes, K, MO, PRE). Figure 2.

Plantae 45–80 cm altae, cormo 8–13 mm in diametro stolonifero, foliis 6 vel 7 inferioribus basalibus laminis planis, caule eramoso, spica erecta (2–)4–7 florum, brac-



Figure 1. *Gladiolus serpenticola*, habit and detail of flowers $\times 0.5$ (from Goldblatt & Manning 9844).

teis pallide viridibus post anthesin supra siccis (15–)23–30 mm longis, floribus pallide carneis tepalis inferioribus atrolineatis tubo perianthii ca. 16 mm longo, tepalis subaequalibus, filamentis ca. 16 mm longis, antheris ca. 8 mm longis.

Plants 45–80 cm high. Corm ovoid, 8–13 mm diam., with stolons produced from the base, these ultimately producing new plants some distance from the parent, the tunics of \pm papery layers, with



Figure 2. *Gladiolus pavonia*, habit and detail of flowers $\times 0.5$ (from Goldblatt & Manning 10131).

age becoming irregularly broken and somewhat fibrous. *Cataphylls* pale and membranous, the uppermost reaching 2–3 cm above the ground and then brownish or purple. *Leaves* six or seven, the lower three or four ± basal and largest, reaching

at least to the base of the spike or sometimes slightly exceeding it, the blades narrowly lanceolate, 8–14 mm wide, usually slightly twisted in the upper halves, the remaining two to three leaves caudine and much smaller than the basal, the uppermost

largely or entirely sheathing, the margins open to the base. *Stem* erect, sometimes flexed outward above the sheaths of the two upper leaves, but remaining erect, unbranched, 2.0–2.3 mm diam. at the base of the spike. *Spike* erect, occasionally 2-, usually 4- to 7-flowered, the flowers in two ranks ca. 50° apart; *bracts* pale green, relatively soft-textured, shortly after anthesis the apices becoming dry and light brown, the outer (15–)23–30 mm long, the inner bracts slightly shorter to about as long as the outer, apiculate or minutely forked apically. *Flowers* pale pink, the upper tepals shading to dark red toward the bases, the dorsal half of the upper part of the tube dark red inside and out, the lower margins of the dorsal tepals with a wide transparent band, the lower lateral tepals lightly streaked with pink longitudinal lines in the lower half, the lower median tepals whitish in the lower half lined with purple longitudinal streaks, the lower tepals also with a white zone with a central red spot just below the tepal sutures, unscented; *perianth tube* obliquely funnel-shaped, ca. 16 mm long, the lower cylindrical part ca. 8 mm long; *tepals* nearly equal and widely spreading, the dorsal slightly larger than the others, ca. 25 × 16 mm, curving outward below, erect above, the upper laterals patent in the upper half, 24–26 × 15 mm, the lower three tepals slightly inclined below, recurved in the upper half, 21–24 × 12 mm. *Filaments* ca. 16 mm long, reddish in the lower half, exserted for ca. 8 mm; *anthers* ca. 8 mm long, tilting below the horizontal, dark purple, the pollen cream. *Ovary* oblong, ca. 6 mm long; *style* arching over the stamens, dividing between the base and middle of the anthers, the branches 5–6 mm long, expanded and bilobed at the apices. *Capsules* ovoid, 21–24 mm long, three-lobed above and retuse; *seeds* evidently oval, ca. 7 mm long, the wing apparently well developed, light brown (fully mature seeds not seen).

Flowering late November and December, occasionally until late January.

Etymology. *Pavonia*, peacock in Latin, alluding to the dark eye on the center of the flower as in a peacock feather.

Distribution and habitat. A rare, narrow endemic, *Gladiolus pavonia* is recorded from the mountains south of the Strydom Tunnel on the slopes of the Abel Erasmus Pass in Mpumalanga Province, South Africa. Plants grow on semiarid stony dolomite hills in light woodland, and seem to favor shaded or open, exposed sites equally. They produce several stolons from the corm bases and form small clones, several juvenile plants surrounding the larger parent plants. Our observations suggest

that *G. pavonia* favors steeper slopes that receive slightly more precipitation than the surrounding hills. Although known from only two sites in the area, we suspect that it is more widespread in the dolomite belt that extends to the north and south along the Drakensberg Range interior to the escarpment edge (Matthews et al., 1993). The early summer of 1994 when we collected the plants for the illustrations reproduced here was exceptionally dry and very few individuals produced flowering spikes. In years of higher rainfall we suspect that the species produces a fine display of flowers. *Gladiolus pavonia* appears to be a prime plant for cultivation in the small garden, especially in dry areas of the summer rainfall area.

Diagnosis and relationships. *Gladiolus pavonia* can be distinguished by its pale pink flower with a tube 33 mm long, nearly equal tepals 21–25 mm long, and circle of dark red color at the mouth of the perianth tube. The leaves are also unusually softly textured, somewhat surprising for a plant of a dry habitat. Also unusual are the pale, fairly thick stolons produced from the corm bases, each terminating in a small cormlet. The relationships of *G. pavonia* lie with the eastern southern African members of section *Blandi*, which include the Drakensberg species, *G. microcarpus*, *G. cataractarum* from near Dullstroom in Mpumalanga Province, and *G. brachyphyllus* from the Mpumalanga Lowveld and adjacent parts of Swaziland and Mozambique. Of these, *G. brachyphyllus* most closely resembles *G. pavonia* in its comparatively short perianth tube and general flower structure, but it differs notably in having dark pink flowers with a white median streak on each of the lower tepals, and the leaves of flowering plants have very short or vestigial blades.

Paratypes. SOUTH AFRICA. Mpumalanga: 2430 (Pilgrim's Rest) Lydenburg District, Farm Nooitgedacht, dolomite ridges in *Kirkia wilmsii* woodland, 1260 m (DA), 30 Nov. 1987, Raal & Raal 1781 (J), 21 Dec. 1989, Boyd 66 (E, J, MO, NBG).

NEW COMBINATIONS AND CHANGES IN RANK

1. ***Gladiolus miniatus* Ecklon, Topogr. Verz. 40. 1827.** *Gladiolus floribundus* subsp. *miniatus* (Ecklon) Obermeyer in Lewis et al., J. S. African Bot., Suppl. 10: 103. 1972. TYPE: South Africa. Western Cape: without precise locality but probably from near Cape Agulhas, 25 Nov., Ecklon 323 (lectotype, designated by Lewis et al. (1972: 103), S not seen; K, photo).

Recognized as early as 1827 by the Danish botanist C. F. Ecklon, *Gladiolus miniatus* was most likely based on his collections from near Cape Agulhas (Lewis et al., 1972). The species was overlooked by Baker (1896) in his treatment of *Gladiolus* for *Flora Capensis*, and it was subsequently regarded as one of five subspecies of *G. floribundus* by Obermeyer in Lewis et al. (1972). They did not regard its salmon-orange perianth and long, cylindrical upper perianth tube to be different enough to merit its being treated as a separate species. We believe that Lewis et al.'s (1972) circumscription of *G. floribundus* is too broad and inclusive. The two short-tubed subspecies, subsp. *milleri* (Ker Gawler) Obermeyer and subsp. *rudis* (Lichtenstein ex Roeper & Schultes) Obermeyer should be treated as a single species separate from *G. floribundus*, and the long-tubed and red-flowered subspecies *miniatus* should be recognized at species rank. Thus the members of the *G. floribundus* alliance sensu Lewis et al. (1972) are probably best treated as three separate species. These are *G. floribundus*, including subspecies *fasciatus*, with greenish to cream or pale pink flowers and a moderately long and narrowly funnel-shaped perianth tube; *G. milleri* Ker Gawler, with white to pink flowers with a short perianth tube; and *G. miniatus*, with orange-red flowers and an extended perianth tube, the upper part of which is tubular.

Each of the three species favors a different habitat. *Gladiolus floribundus* most often occurs in fairly dry sites on rocky, sandstone-derived soils or occasionally on limestone in sandy ground. *Gladiolus milleri* usually grows on clay- and shale-derived substrates but occasionally in sandy soils in areas of high rainfall. *Gladiolus miniatus* has the most restricted range and specialized habitat. It is restricted to limestone outcrops along the southern coast of Western Cape Province extending from Hawston near Hermanus in the west to Riversdale in the east. Plants always occur just a short distance from the sea and in association with limestone outcrops. The immediately related *G. floribundus* may also grow close to the coast and sometimes in limestone outcrops, but it maintains its typical morphology and has either pink or greenish flowers and shows no tendency to intergrade with *G. miniatus*. Both *G. floribundus* and *G. milleri* have wider ranges than *G. miniatus*, extending from the western Cape mountains to the Port Elizabeth District in Eastern Cape Province.

The morphological differences in perianth tube length and the associated perianth color and markings presumably reflect adaptations for different pollination strategies. Our observations (unpublished)

indicate that *G. milleri*, which has a relatively short perianth tube, is pollinated by long-tongued anthophorid bees, *Anthophora diversipes* being the most important. The floral morphology of *G. floribundus*, including the long perianth tube and longitudinal streaks on the lower tepals, is consistent with pollination by long-tongued flies, either *Philoliche* (Tabanidae) or *Prosoeca* (Nemestrinidae) (Vogel, 1954; Goldblatt et al., 1995; Manning & Goldblatt, 1996). *Gladiolus miniatus*, with its orange-red flowers with a long tube with an elongated and tubular upper portion, is most likely pollinated by sunbirds (*Nectarinia* spp.). Both flower color and tube shape and length are consistent with the assumption of bird pollination in other species of *Gladiolus*, e.g., *G. watsonius* Thunberg (Rebelo, 1987). Several species of other genera of Iridaceae, including *Chasmanthe*, *Tritoniopsis*, and *Watsonia*, which have similarly shaped and colored flowers, are pollinated by sunbirds (Goldblatt, 1989; Rebelo, 1987; Goldblatt & Manning, unpublished).

Additional specimens examined. SOUTH AFRICA. **Western Cape:** 3419 (Caledon) 3 km (2 mi.) E of Hawston (AC), 31 Oct. 1953, Cloete s.n. (SAM); Onrust River, surface limestone on sand hills, 22 Nov. 1934, F. Esterhuysen s.n. (BOL); 3420 (Bredasdorp) inland from Struys Bay (CC), Leipoldt 3589 (BOL); near Arniston, limestone coastal fynbos, 32 m, 13 Oct. 1969, Acocks 24255 (K); near Zoetendals Vlei, Oct. 1940, Esterhuysen 3559 (BOL).

2. *Gladiolus variegatus* (G. Lewis) Goldblatt & Manning, comb. et stat. nov. Basionym: *Gladiolus debilis* var. *variegatus* G. Lewis in Lewis et al., J. S. African Bot., Suppl. 10: 188 (1972). TYPE: South Africa. Western Cape: Bredasdorp District, Brandfontein, 14 Oct. 1951, Esterhuysen 19087 (holotype, BOL; isotypes, NBG, PRE).

Restricted to the southern Cape coast between Stanford and Cape Agulhas, thus only on the western side of the Agulhas Peninsula, Western Cape Province, South Africa, *Gladiolus variegatus* grows only short distances from the sea coast in cracks in limestone outcrops or in stony calciferous sands. The species can immediately be recognized by its white or pale pink flowers with unusual nectar guides consisting of unevenly sized, dark red spots distributed across the lower two-thirds of the lower tepals and the lower part of the throat. The markings differ on each tepal and on every flower, a condition that is unusual in *Gladiolus* where tepal markings are normally symmetrical and consistent for an individual.

Gladiolus variegatus resembles most closely the southwestern Cape mountain species *G. debilis* Ker

Gawler, and it was treated as a variety of that species by Lewis et al. (1972). As these authors pointed out, the two taxa differ in several respects, including the nectar guides, which are variously shaped in *G. debilis* but most often consist of diamond-, spade-, or chevron-shaped markings on the lower tepals. In *G. debilis* the floral bracts are 15–25 mm long and have a ridged surface, whereas the bracts are (25–)30–45 mm long and smooth in *G. variegatus*. Perhaps most significantly, leaf shape and number also differ between the two species. *Gladiolus variegatus* typically has three leaves (occasional robust individuals may have four), the blades are 1.5–2 mm wide and plane with lightly raised midribs, and the margins are unthickened. *Gladiolus debilis*, however, normally has four leaves, the lower two with blades 1–1.5 mm wide, with moderately to strongly thickened midribs and margins. In addition, the flowers of *G. variegatus* appear to be somewhat larger than those of *G. debilis* and have the dorsal tepal 20–28 × 13–22 mm, the lower tepals 18–24 mm long, the filaments 12–15 mm long, and the anthers 8–10 mm long. Flowers of *G. debilis* have the dorsal tepal 17–27 × 10–22 mm, the lower tepals 15–24 mm long, the filaments 4–10 mm long, and the anthers 5–9 mm long. The combined qualitative and quantitative differences between *G. variegatus* and *G. debilis* make it easy to distinguish the two and are of sufficient magnitude that they be regarded as separate species. We assume that they are an immediately related species pair, one adapted to stony sandstone-derived soils of the southwestern Cape mountains, and the other to coastal limestone soils of the nearby coast. They share the following synapomorphies: a white to pale pink flower with red nectar guides, a relatively long perianth tube, and similar hard-textured corm tunics consisting of thick parallel vertical fibers.

Gladiolus variegatus and *G. miniatus* join a small number of limestone endemics known from the southern Cape coastal belt (Heydenrich et al., 1994), including in the Iridaceae *Hesperantha juncea* and *Watsonia fergusoniae*. This area has a flora distinct enough that it was treated by Weimarck (1941) as one of several centers of endemism in the Cape Floristic Region.

Additional specimens examined. SOUTH AFRICA.
Western Cape: 3419 (Caledon) Grootbos, off the Stanford-Gansbaai road (CB), 19 Sep. 1966, Chater s.n. (NBG); Ratelrivier, S of Viljoenshof, limestone outcrops (DA), 27 Sep. 1968, Goldblatt 333 (BOL); 3420 (Bredasdorp) near Cape Agulhas (CC), 18 Sep. 1962, Nordenstam 1455 (NBG).

3. *Gladiolus caeruleus* Goldblatt & Manning, nom. nov. pro *Gladiolus gracilis* var. *latifolius* G. Lewis in Lewis et al., J. S. African Bot., Suppl. 10: 228. 1972, not *Gladiolus latifolius* Lamarck (1791) (= *Babiana villosa* (Aiton) Ker Gawler). TYPE: South Africa. Western Cape: road to Donkergat N of Churchhaven, 15 Aug. 1966, Barker 10395 (holotype, NBG; isotype, K).

Although it was treated by Lewis et al. (1972) as variety *latifolius* of the widespread *Gladiolus gracilis* Jacquin, we regard the two taxa as separate species. Both share pale blue flowers and an apomorphic leaf type in which the leaf margins are raised into wings, rendering the blade H-shaped in transverse section. No doubt the two are closely related, sharing at least the synapomorphic H-shaped leaf, but they differ in several notable features. *Gladiolus caeruleus* has spikes of (4–)8–14 flowers, and the floral bracts are 25–40 mm long and without the extended twisted apices characteristic of *G. gracilis*, which normally has spikes of 3–5 flowers. In addition, the flowers of *G. caeruleus* are fairly large, and the lower tepals are subequal and obtuse to subacute. The leaf blades are relatively broad, 4–7 mm wide with the marginal wings extended ± at right angles to the blade surface. In contrast, *G. gracilis* usually has smaller flowers, floral bracts 33–37 mm long, the lower tepals acute to subacute and unequal, the lowermost being notably longer than the lower laterals, and the leaf blades comparatively narrow, 1.5–2 mm wide, with the marginal wings curved downward toward the blade surface.

Gladiolus caeruleus is a local endemic of the southwestern coast of Western Cape Province where it occurs from Yzerfontein in the south to the hills above Cape Columbine north of Saldanha Bay. Plants are only known from a few sites, always growing in sandy soils in limestone outcrops or on calcareous sands close to the coast. Despite occurring relatively close to Cape Town, and in areas that have been relatively well botanized, records of *G. caeruleus* are scanty. The first collection seems to have been that made by Frances Leighton in 1946.

The existence of the name *Gladiolus latifolius* Lamarck (1791), a later synonym of *Babiana villosa* (Aiton) Ker Gawler, makes it necessary to rename this plant when recognized at species rank in *Gladiolus*.

Additional specimens examined. SOUTH AFRICA.
Western Cape: 3218 (Clanwilliam) Langebaanweg, rocky flats near Airforce Base (CC), 16 Aug. 1994, Goldblatt & Manning 9928 (MO); 3317 (Saldanha) Donkergat road N

of Churchhaven (BB), 15 Aug. 1966, *Barker* 10395 (NBG); Danger Bay, 13 Aug. 1946, *Leighton* 1721 (BOL, NBG); 3318 (Cape Town) N of Darling-Yzerfontein intersection on R27, sandy limestone hills (AA), 8 Aug. 1995, *Goldblatt & Manning* 10232 (MO, NBG).

Acknowledgments. Fieldwork was supported by grant 4816-92 from the National Geographic Society. We thank Jan Vlok, Western Cape Department of Nature Conservation, Kobie Truter, Langebaanweg Airforce Base, and Etienne van Blerk, Bredasdorp Airforce Base, for their help in the field.

Literature Cited

Baker, J. G. 1896. Iridaceae. Pp. 7-171 in W. T. Thiselton-Dyer (editor), *Flora Capensis*, Vol. 6. Reeve, Ashford.

Goldblatt, P. 1989. The Genus *Watsonia*. Ann. Kirstenbosch Bot. Gard. 17: 1-148.

—, J. C. Manning & P. Bernhardt. 1995. Pollination biology of *Lapeirousia* subgenus *Lapeirousia* (Iridaceae) in southern Africa: Floral divergence and adaptation for long-tongued fly pollination. Ann. Missouri Bot. Gard. 82: 517-534.

Heydenrich, B., C. Willis & C. Burgers. 1994. Limestone fynbos. *Veld & Flora* 80(3): 68-72.

Kruckeberg, A. R. 1986. The stimulus of unusual geologies for plant speciation. *Syst. Bot.* 11: 455-463.

— & Rabinowitz. 1985. Biological aspects of endemism in higher plants. *Ann. Rev. Ecol. Syst.* 16: 447-479.

Lewis, G. J., A. A. Obermeyer & T. T. Barnard. 1972. A revision of the South African species of *Gladiolus*. *J. S. African Bot.*, Suppl. 10: 1-316.

Manning, J. C. & P. Goldblatt. 1996. The *Prosoeca peringueyi* (Diptera: Nemestrinidae) pollination guild in southern Africa: Long-tongued flies and their tubular flowers. *Ann. Missouri Bot. Gard.* 83: 67-86.

Matthews, W. S., A. E. van Wyk & G. J. Bredenkamp. 1993. Endemic flora of the north-eastern Transvaal escarpment, South Africa. *Biol. Conserv.* 63: 83-94.

Morrey, D. R., K. Balkwill & M.-J. Balkwill. 1989. Studies on serpentine flora: Preliminary analyses of soils and vegetation associated with serpentinite rock formations in the southeastern Transvaal. *S. African J. Bot.* 55: 171-177.

Rebelo, A. G. 1987. Bird pollination in the Cape flora. Pp. 83-108 in A. G. Rebelo (editor), *A Preliminary Synthesis of Pollination Biology in the Cape Flora*. African Nat. Sci. Progr. Rep. 141. CSIR, Pretoria.

Vogel, S. 1954. Blütenbiologische Typen als Elemente der Sippengliederung. *Bot. Stud.* 1: 1-338.

Weimarck, H. 1941. Phytogeographical groups, centres and intervals within the Cape flora. *Lunds Univ. Arsskr.* N. F. Avd. 2, 37(5): 1-143.

Wild, H. 1978. The vegetation of heavy metal and other toxic soils. Pp. 1301-1332 in M. J. A. Werger (editor), *Biogeography and Ecology of Southern Africa*, vol. 2. W. Junk, The Hague.